

COMMENTARY

In the face of the storm: three habitats shield the coast from hurricane-induced erosion

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The intertidal zone is a turbulent place. For organisms living on the coast, that means dealing with hazards from both land and sea. Fortunately, these denizens of the not-so-deep can rely on the “Power of Three”: coral reefs, seagrass meadows, and mangroves. These structures act as natural barriers and help protect coastal environments from dangers like hurricanes and storm surges that could erode crucial habitat area. The situation doesn’t have to be critical for these barriers to prove their worth, either—they can even reduce day-to-day erosion. However, focusing on only one protective habitat in ecosystem management can be detrimental. The protective habitats perform best in a combination, as layers of protection that complement one another. A recent study set out to demonstrate this complementarity in a stretch of coastline in Belize. Guannel et al. (2016) examined how important these three habitats were in protecting the surrounding seascape from waves, hurricanes and erosion. Coral reefs are often the first line of defense, being further out from shore than the other two protective structures (mangroves and seagrass meadows). Some of the study sites had

live corals on the reef while others were comprised of only dead ones. A seagrass meadow (in this case a meadow of Turtlegrass, *Thalassia testudinum*) is generally found inshore of the coral reef, between the reef and the beach (see Figure 1). This forms another protective “layer.” Mangrove forests are located even closer to the shore, in the intertidal zone.

Using a bathymetric profile (i.e., measuring the underwater depths in oceans, seas and lakes) of these three habitats, researchers modelled the effect of normal, everyday waves and those induced by hurricanes. The study found that live coral reefs reduced wave height much more than dead reefs. Reefs with live coral cover are higher and interfere more with waves, and are therefore more effective at reducing erosion (all the more reason to fight for coral conservation!). Using models, researchers also predicted what future conditions would be like if sea levels rose by one metre. Live corals would continue to grow and maintain their efficiency at reducing erosion, while dead reefs lie inert, becoming less effective wave-breakers as the water

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level rises. However, if the corals are dead, seagrass meadows can rescue the situation. They can reduce waves and related shore-stresses far more than a

dead reef alone. However, seagrass meadows combined with a live coral reef function even better than either habitat by itself.

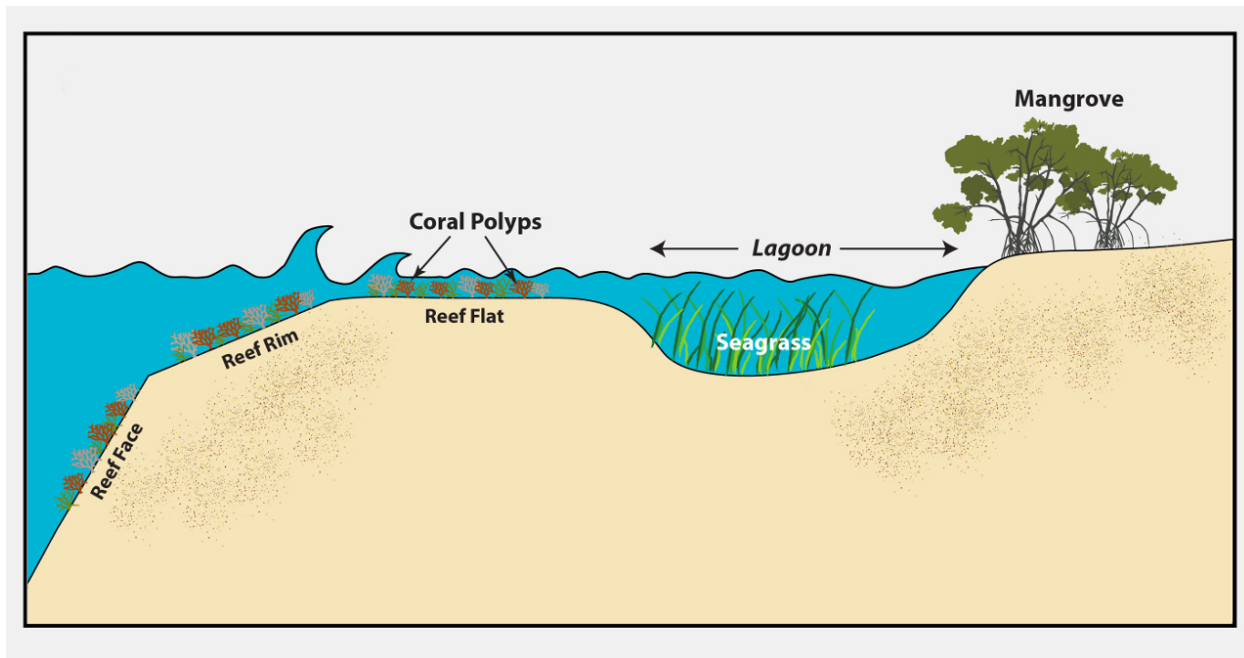


Figure 1: Model of plant barrier types along intertidal depths from Guannel et al. 2016.

This is an excellent example of what scientists call complementarity.

Mangrove forests are the most independent of the three habitats. Their effect (a 70% wave height reduction) is the same whether or not the other two protective habitats are present. Because mangroves present a tangle of roots and trunks for waves to navigate, it is perhaps not surprising that they are a very strong barrier to erosion. However, they are much further inshore, so a wave has probably already lost most of its height and energy by the time it arrives. Mangroves are also by far the most effective of the three habitats against hurricane

disturbance. Still, more erosion does occur if they're the lone protector. Whichever way you look at it, shoreline protection was best achieved as a team effort.

Literature Cited

Guannel, G., K. Arkema, P. Ruggiero, G. Verutes. 2016. The power of three: Coral reefs, seagrasses and mangroves protect coastal regions and increase their resilience. *PloS One* 11.7: e0158094.